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LINE MAPPING FROM SATELLITES IN THE ORDNANCE SURVEY

BY

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Summary
This is an account of an actual production task using SPOT imagery. It also reviews the future of mapping from sensors in space and concludes that they have a role to play in future development and aid.

LINE MAPPING FROM SATELLITES IN THE ORDNANCE SURVEY

The current emphasis in the geographic and land information community on Geographic Information Systems (GIS) tends to take for granted the existence and accuracy of the topographic maps on which they are invariably based. In the UK we are fortunate in having some of the best medium scale mapping in the world at 1:50 000. In developing countries this may not be the case. While maps, at some scale, exist in most of the developing world, much of the cover is so out of date that it cannot be relied upon as a basis for identifying potential for new development. Some areas were mapped in the early years, by techniques that gave accuracy standards that are no longer acceptable for any purpose except basic navigation. As countries develop, or areas of potential are identified maps at scales larger than the existing 1:200 000 or 1:250 000 become necessary.

The basic techniques for topographic mapping have remained much the same for forty years. Stereo air photography is used as the basic source document, contours and topographic details being plotted photogrammetricly. Surveyed ground control is needed to orientate and scale the stereo models and field completion teams are needed to provide the essential information which is rarely apparent on any imagery; boundaries, road classifications, place names etc.

Over the years the costs of acquiring data and land information of all kinds and the heights of the sensors used to capture this data have risen progressively. One of the recent innovations in data capture has been the French SPOT-1 satellite which has been in a 'near Polar' circular orbit since February 1986. With its 10m pixel size, panchromatic image, off nadir viewing capacity, stereo capability and ability to accept commissions for imagery of specific areas, SPOT has characteristics which should be a boon to the cartographic community. The development of SPOT has generated a great deal of interest in the remote sensing and scientific community but despite many encouraging claims as to its utility and accuracy, so far very few cost effective products or processes have been developed.

Within the framework of an Overseas Development Administration funded topographic mapping program in the Yemen Arab Republic the Overseas Surveys Directorate of OS has experimented with the use of SPOT as a primary data source and has now started a production mapping programme. An area of 25 000 sq km in the north east of the country is being mapped at 1:100 000 scale with contours. Twenty eight SPOT scenes have been commissioned and a field survey team spent some months in this arid and unfriendly environment establishing the ground control necessary for mapping. It is a very good test bed for assessing satellite imagery; there is little vegetation to hide detail and there is virtually no cloud to prevent data capture. SPOT like all

visible band sensors cannot see through cloud, a vital but often underestimated limitation to most earth pointing remote sensors.

Mapping from SPOT is not simply a matter of tracing off detail from the imagery onto the map, the geometry of the image is both complex and dynamic. The SPOT HRV sensor has an array of 6000 Charged Couple Device sensors which sample reflected radiation every few micro seconds to create a digital image of a swath 10m long and 60km wide. Every swath has a perspective but off nadir view. A whole image is built up swath by swath while the satellite rotates around its Y axis to keep the sensor pointing at the earth. During the seven seconds it takes to record a 60km x 60km ground image the earth has revolved by up to 3.2km (at the equator) which means that an apparently square image represents a perspective view across a skewed area on the earth's surface. The complex geometry is compounded when using stereo imagery as the X axes of the two images taken of the same ground area from different orbits are converging (as the orbits of the satellites converge at the Poles). Discussion of the subject is further complicated as if the Z axis of the satellite is projected from the earth's centre through the satellite and a satellite's X axis is in the plane of the orbit the satellite's Y axis is nearly parallel to the X axis of the stereo image in the photogrammetric convention.

To make matters even more complex the satellite has perturbations ie it rocks about its axes and varies in its attitude, height and velocity. The end effect is such that a line which is straight on the ground appears as a wavy, skewed, far from straight, line on the image. Ground control points of known geodetic position which are positively identifiable on the image allow polynomial modelling of the image data to achieve photogrammetric restitution, in other words a scaled, orientated and usable model of the terrain. University College, London have developed the necessary algorithms and written these as software for use on an analytic photogrammetric plotter. Ordnance Survey quickly saw the benefit of such software and installed it on their own plotters.

The digital data, downloaded from SPOT, is not much use unless it can be seen, measured and interpreted. This is done by loading it into a digital image processing machine where the contrast can be manipulated to achieve a well toned and enhanced image. This is then plotted onto film using a laser plotting device where each original pixel, or data cell, is plotted at 30 micron size. The hardcopy image can then be loaded into the analytic plotter, surveyed control points and the satellite ephemerides data are entered into the system software and the processor calculates the photogrammetic solution. In effect, for any position selected in the model the computer first calculates the image coordinates then moves the left or right images to create a viewable model, then computes the ground co-ordinates and

finally moves the plotting head to the appropriate point on the new map plot. This complex calculation takes place fifty times a second which means that an operator can move his viewpoint around the image model in real time without any noticeable time lag.

Providing that sufficient ground control is available, that attitude variations in the satellite during the seven or so seconds required to expose the image are linear and the operator can distinguish ground features, the output map is effectively no different from any other small scale map.

There has, however, been a tendency for satellite data to be oversold in the past. A variety of tests undertaken in universities throughout the world have all indicated better than expected geometric accuracy and fidelity. Few workers like to advertise shortcomings but SPOT does have significant limitations. The 10m resolution makes positive identifications of features difficult or sometimes impossible. Data when you want and where you want it difficult to obtain, cloud, mist, dust or operational pressures on the satellite preclude early data acquisition and digital data is not necessarily any cheaper than air photography. The ambiguities in identification require more ground effort to confirm detail and to show the necessary classifications which help to make the topographic map usable. The greatest savings appear to be in plotting and computing times and, of course, the obtaining of data where local political pressure would preclude normal air photo sorties. Data acquired from space will not revolutionise mapping but will help it to evolve. OS regards this new data source as just that, another data form, with associated techniques and tools to help in producing an often underrated but vital value added product - a map.

The future for mapping from space seems to be assured. France is planning a continuous SPOT programme into the 21st century. The United States of America has recently announced plans for a 5m resolution scanner aboard the Landsat 6 satellite. Meanwhile the Soviet Union has recently made available, from their KFA-1000 camera, 1m resolution photographic data. The competition to supply high resolution data from satellites in low orbits appears to be increasing.

The British large scale map archive is not likely to be updated and revised by satellite data for a long time, if at all; a resolution of at least 1m will be required for that, but it is likely that, even with a complex urbanised landscape, maps at 1:25 000 scale and smaller may be revised from such data sources within the next decade.

The main market for such systems remains in the developing countries where basic topographic archives are so often out of date. It seems ironic that the technology transfer involved in

equipping local survey departments in the British Commonwealth over the last two decades can now be seen to leave us essentially as we were when we started. The developed world still has better data, techniques and expertise, the developing countries have the need.

Future developments in mapping systems are likely to revolve around a totally digital approach. Producing film from digital data (and vice versa) tends to degrade the image quality and interpretability so it makes good sense to keep the data in digital form. Image processing hardware and software is likely to be used more and more in traditional photogrammetry and map compilation. Already it is possible to produce digital terrain models from digital data fully automaticly: it can be but a few years before expert systems, artificial intelligence and computer vision systems, at present the subject of research, allow automatic feature recognition, extraction and labelling. In short, totally automated mapping.

This is a time of increasing commercial competitiveness in the mapping field and, indeed, in all types of aid input. With extreme economic pressures, and immediate human needs for food, shelter and disaster aid effecting many countries it is difficult to maintain a proper balance between the supply of such immediate necessities and the maintenance of the accurate geographic information which will underlie efficient and cost effective development in the future. Mapping, be it digital or conventional, old style paper sheets or new sounding geographic information, must take advantage of all opportunities to supply data more cheaply and more quickly. The use of satellite imagery needs further research and, more importantly, development before its true place in the cartographers' armoury is determined

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REPORT ON STATUS OF STANDARDIZATION OF GEOGRAPHICAL NAMES IN THE AFRICA EAST DIVISION

by

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Abstract

The paper reviews the status of standardization of geographical names in the Africa East Division. It presents the benefits that accrue from standardization of geographical names not only to Africa but also to the rest of the world. It further stresses that for standardization of geographical names to flourish in the Division, regular bilateral and multilateral meetings and training are a pre-requisite; this is of course also true for the whole of Africa and the rest of the world.

I. INTRODUCTION

1. The development of National Committees on Standardization of Geographical Names has grown steadily in the Africa East Division. This has been greatly necessitated by the fact that most of the countries are multi-tribal. And, one element of effective communication is the ability to refer to particular places, features and areas on the surface of the earth. This can only be accomplished by the use of geographical names, a reference system found in every known language. Names, however, can vary in selection, spelling and application between different users of the names.

2. Realizing the importance of standardization of geographical names, the United Nations, since 1960, sanctioned the functioning within its framework of a group of experts promoting the international standardization of geographical names. The group, now called the United Nations Group of Experts on Geographical Names (UNGEGN), working in close co-operation with the United Nations Secretariat, has so far organized international conferences normally known as United Nations International Conferences on the Standardization of Geographical Names (UNICSGN). Since 1968, the UNGEGN, whose work is accomplished by working groups, has been meeting about once every two years; on the other hand, UNICSGN, whose work is similarly accomplished by working groups, has held its conferences about every five years. Now, because of its international nature, the United Nations was considered to be the logical place to co-ordinate and encourage the international standardization of names.

3. And, linguistic/geographical divisions were formed in order to implement the recommendations of the resolutions adopted at the United Nations Conferences at both national and international levels.

4. Africa is divided into three divisions as follows:

(a) Africa Central Division: The Division comprises Angola, Burundi, the Central Africa Republic, Chad, the Congo, Equatorial Guinea, Gabon, Rwanda, Sao Tome and Principe, Cameroon and Zaire;

(b) Africa East Division: It comprises Botswana, Comoros, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, Swaziland, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe;

(c) Africa West Division: The Division comprises Benin, Burkina Faso, Cape Verde,the Gambia, Ghana, Guinea, Guinea-Bissau, Cote d'Ivoire, Liberia, Mali, Mauritania, the Niger, Nigeria, Senegal, Sierra Leone and Togo; and

(d) It is to be noted that African Arab countries have been put together with other Arab nations to form Arabic Division. (Algeria, Djibouti, Egypt, the Libyian Arab Jamahiriya, Morocco, Somalia, the Sudan, Tunisia).

II. CONTRIBUTIONS OF STANDARDIZATION OF GEOGRAPHICAL NAMES TO DEVELOPMENT

5. The following benefits are not only relevant to Africa but also to the rest of the world:

(a) Cartography is in constant process of development due to newly acquired techniques and technologies. The different variables in the development of cartography develop at varying degrees. Geographical names is one such variable. Geographical names, in their written form, are a vital part of a map. It is inconvenable that maps could function as a viable communication system without the use of names. Standardization of geographical names thus enhances cartographic development;

(b) The national standardization of geographical names fixes the geographical names of a nation in a linguistically correct form. The result is a cultural achievement since the names fixed on maps and gazetteers represent an important source for any research into historical patterns of settlement or into economic and ethnic history. Fixing geographical names in multilingual areas is a cultural and political task of major importance for the co-existence of language groups in a nation. The value of the names will depend on how carefully and painstakingly the names have been collected and recorded;

(c) The standardization of geographical names plays a major role in transport and communications, both national and international. This necessitates that each significant place, feature or area of a country must necessarily have an acknowledged and unequivocal name, along with variants in regions that are legally multilingual. It is then that international timetables for airlines and railways become implementable with definite place names;

(d) Standardized names imply accurate names information and names data bases. This is of social, economic and political importance; with definite place names no resources are wasted by government, industry, commerce, business, citizens, etc., in verification. Definite place names are particularly useful to famine relief teams, fire-fighting and rescue teams and similar disaster-control operations;

(e) Standardization of geographical names enhances international co-operation. There is a lot that each nation gains in participating with other nations in the United Nations meetings on standardization of geographical names;

(f) National standardization of geographical names allows each country to exercise prerogative to determine its own official names. A nation would consequently contribute to the international standardization, particularly on features which cross the borders and those beyond a sovereignty; for instance, maritime and undersea features.

III. ACHIEVEMENT IN THE AFRICA EAST DIVISION

6. Standardization of geographical names nas reached various stages in the countries forming the Africa East Division. It is at this point pertinent to review the achievements of each country in the Division.

A. The Republic of Kenya

7. The activities of standardization of geographical names have continued in the Republic. All new names which have been collected during the up-dating of topographical maps have been processed by the standing committee on geographical names and included in the printed maps. It is estimated that approximately 9,000 place names or 250 maps sheets have been dealt with in the last five or so years. A revision copy of the gazetteer and a card index system for new and amended names continue to be maintained for the purposes of publishing the third edition of the gazetteer. And, a small gazetteer has been compiled for the fourth edition of the National Atlas; it contains approximately 2,000 place names which appear in the atlas.

8. The standing committee on standardization of geographical names is presently involved in the preparation of Toponymic Guidelines for Map and other Editors.

B. The Republic of Botswana

9. The Place Name Commission was established by a Presidential Directive (CAB 51/67) dated 11 October 1967, and the Surveyor-General was appointed Chairman of the Commission. By December 1970, the Commission had met 26 times and discussed 1,043 names. By July 1981, the Commission had held 77 formal meetings at which over 2500 names were discussed; it also published a second list of Names and Recommended Spellings.

C. The Republic of Malawi

10. Malawi has not as yet set up any national committee on the standardization of geographical names and hence the exercise on standardization of names has not been embarked upon. There is all the same a need for proceedings of conferences on geographical names to be sent to Malawi for dissemination of information.

D. The People's Republic of Mozambique

11. The Republic is experiencing some problems with the names along its borders where the neighbouring countries do not recognize its (Mozambique's) official version of the names. It intends to publish a coded booklet in alphabetical order

listing all the names in its national atlas. If the list will be too valuminous then a computer-assisted system may be employed. The Republic is keen on international standardization of names and hopes that some day standardized geographical names, symbols, conventions and letters will be published for Eastern Africa in particular and Africa in general. Mozambique has also shown great interest in short training courses in toponym and hope that it will be invited to participate.

E. Swaziland

12. Swaziland has a Place Names Committee but it has not met for years.

13. The Surveyor-General's office plans to reconstruct the 31 sheets of 1:50,000 scale mapping and the names on these were compiled in the early 1950s by the British Directorate of Colonial Surveys. The Surveyor-General has no information as to the sources of these names. The major overhaul proposed for the map series would be an ideal opportunity to correct and complete the place names.

14. It is hoped that the Swaziland Place Names Committee will be revived and that an accurate list of place names in Swaziland can be compiled. Possibly this list could also include translations of the Siswati names and the source of names of European or other origins.

F. United Republic of Tanzania

15. Since the fourth Conference at Geneva in 1982, the Surveys and Mapping Division of the Ministry of Lands, Natural Resources and Tourism has managed to put through Parliament an act for the establishment of a National Geographical Names Standardization Committee, Act No. 23 of 1982. The Committee was formally established with 18 members effective 13 June 1983 and for a term of three years which ran out. It is to be noted that various recommendations of this first Committee are still under consideration. The second Committee was to be formed to continue with the tasks left uncompleted by the first one.

G. The Republic of Uganda

16. Regrettably, since the last Conference in Athens in 1977, Uganda has been passing through a difficult political era which has not been conducive to undertaking any constructive mapping programme. However, it is hoped that in the near future the District Standing Committees on Standardization of Geographical Names will be revitalized as the Department of Surveys and Mapping launches new mapping programmes.

H. The Republic of Zambia

17. Zambia has not done much in the area of the Standardization of Geographical Names. However, the Government appointed a Standing Committee in 1978 whose terms of reference were to advise the Government on matters relating to geographical nomenclature in Zambia. The Committee is composed of surveyors, geographers, cartographers, historians, linguists and administrators.

18. Ever since the Committee was appointed, much of its work has been confined to the revision of the National Gazetteer of Geographical Names which was last published in 1966.

19. In addition to the revision, the Committee is working towards the direction of re-organizing the local sub-committees at both provincial and district levels in order to effectively formulate the policies of the standardization of names in the country. But it is regrettably observed that the Committee's work is being retarded due to lack of enthusiasm on the part of the appropriate authority towards its effectiveness.

20. However, efforts are being made by the Surveys Department to re-organize the Committee and stimulate the higher authorities on the importance of standardizing geographical place names in the country. According to the Standing Committee's plans, it is to increase the names from the present 35,000 contained in the 1966 edition to about 45,000 names.

I. The Republic of Zimbabwe

21. Zimbabwe has a Geographical Names Standing Committee (GNSC) of which the Surveyor-General is Chairman. The activities of GNSC can be illustrated from the extracts of the Surveyor-General's annual report for 1986, in which he stated:

(a) "The Geographical Names Standing Committee had two meetings during the year. One was a special meeting held just three days after the regular GNSC meeting to check names submitted by the Cabinet Committee on Place Names (CCPN);

(b) Spellings of 1,339 names were checked on the preparatory lists and CCPN. Of these, 1,217 were verified and 122 were referred back to District Administration and GNSC for more information on meaning of place names."

22. Zimbabwe has not in any way been associated with the past Conferences on the Standardization of Geographical Names.

J. The Republic of Seychelles

23. Following a decision of the Council of Ministers of the Seychelles, on the 14 August 1980, the Ministry of Planning and Development and the Ministry of Education and Information were mandated to "deal with the prevalence of invented names of localities in Seychelles". A small committee was therefore formed to review and, where necessary, revise the place names of Seychelles which consists of 115 small islands.

24. The committee met for the first time on the 18 October 1980, and since then, has been meeting fortnightly.

25. The committee has produced a revised list of the island names and is on the point of completing a review of place names of the various islands of the Republic, including those of the outlying coral islands. The main review work has been in connection with the main islands of Mahe, Praslin and La Digue.

26. It plans to compile a toponymic dictionary of Seychelles place names once it will have completed its review work.

K. Socialist Ethiopia

27. The Standardization of Geographical Names forms part of the list of priorities of the People's Democratic Republic of Ethiopia.

L. Other Member Countries of the Division

28. No information has been received from some member countries of the Division, namely Lesotho, Madagascar and Mauritius; however, it is expected that activities in the field of geographical names are going on within the countries.

M. Review of the Status in the Division

29. From the brief reports above it can be noted that nearly all the countries of the Division have got official activities related to standardization of geographical names. Consequently, they must have been aware of the benefits to be derived from standardization of geographical names. Kenya, as Chairman of the Division, has constantly contacted the members to appraise them on the activities of the UNGEGN and UNICSGN particularly the resolutions of the two institutions.

IV. REVITALIZATION OF STANDARDIZATION OF GEOGRAPHICAL NAMES IN AFRICA EAST DIVISION

A. Holding of Regular Meetings

30. It has been noted in the Division that governments are not giving the National Names Authorities required backing - particularly financial. This is understandable since there are other more urgent projects competing for the limited funds. Again, those in the top management in the government some times are not aware of the socio-economic benefits to be derived from the National Committee on Geographical Names. In this regard, Kenya as Chairman of the Division, will endeavour to encourage regular bilateral and multilateral meetings so that the benefits derived can be publicised to those in top management and the general public. The meetings would help in both reactivating the existing National Committees and in creating new ones in the nations where they do not exist. In this way, conducive environment would be created in which resolutions of the United Nations International Conferences on the Standardization of Geographical Names could be implemented.

B. Training

31. Training in standardization of geographical names is very important. For instance, the personnel involved in the collection of names information should have adequate training to enable them to deal with linguistic problems.

32. Training is also required in office treatment of names, toponymy, gazetteer production, automatic data processing and laws and regulations relating to the management of geographical names.

33. In the fifth United Nations International Conference on the Standardization of Geographical Names held in Montreal, Canada, in August 1987, Kenya reiterated its intention made at the twelfth session of the Group of Experts on Geographical Names held at Geneva, Switzerland, in 1986, to hold a training course in Nairobi, Kenya for the Africa East Division. It is still keen on holding the course.

34. It is also important to stress that the proceedings of the various United Nations conferences and seminars on geographical names be disseminated to all the members so that they are constantly aware of what is going on, particularly resolutions which need implementation.

V. CONCLUSION

35. In conclusion, when discussing cartography in Africa, standardization of geographical names should not be forgotten. Currently, tangible development is discernible in standardization of geographical names in Africa East Division. In order to catalyze the development, regular such regional conferences, seminars, workshops, training sessions are a pre-requisite. It is in these conferences, seminars, etc., that the United Nations should play a key role particularly as far as support funds are concerned; many African countries cannot afford to send their nationals to attend such meetings because of lack of funds.

36. It is hoped that in the near future every African country will have a legal strong National Committee on Geographical Names which can produce linguistically correct names and maintain a gazetteer for the country.

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USE OF LANDSAT TM IMAGERY FOR UPDATING A 1:50,000 SCALE MAP OF MOUNT ELGON FOREST RESERVE IN UGANDA

by

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I. INTRODUCTION

1. The present uncontrolled and irrational destruction of the natural forests in equatorial Africa is likely to drastically offset the balance of the ecosystem of our habitat and thus accelerate the desertification process in the region. Conservation of forests does not only ensure continued supply of wood for timber, charcoal and firewood but also protection of the numerous renewable and non-renewable resources such as soil, water, flora and fauna, all of which are collectively important for the existence of mankind.

2. Continued existence of the humid tropical rain-forests and montane forests in East Africa is threatened by agricultural encroachment and indiscriminate deforestation. The rate and extent of depletion are not determined in most cases due to lack of effective monitoring systems, coupled with limitation of timely resource data and technical manpower to analyse and assess it. This situation has been triggered and, even, enhanced by human population explosion, economic pressure and unpredictable political climate where search for personal wealth has overweighed national interests among societies, thus crippling the law enforcement systems (UNEP, 1988) on the protection of the forest reserves. Uganda has probably gone through all this hard experience like many other countries and, during the course, it has lost large proportions of its natural forests to agriculture including the most precious humid tropical rain-forests and montane-forests. For example, Uganda had a total of 3,090,100 ha (12.7 per cent of the total land) of tropical high forest in 1900 as compared to 729,865 ha (3.03 per cent) in 1987 (UNEP, 1988).

3. This study was motivated by the results of the Uganda environmental data base project, funded by the United Nations Environmental Programme (UNEP) in 1987. The author participated effectively in the analysis of the multi-data LANDSAT MSS imagery for the assessment and mapping of land-use change between 1973 and 1986. Two land-use/cover map overlays were produced from this data set for UNEP at a scale of 1:500,000. The information so obtained was digitized into the geographical information system (GIS) data base of Uganda (GRID, 1987) by the Global. Resource and Information Data which operates under the auspices of UNEP.

4. The results of this project (UNEP, 1987) revealed the danger of rapid destruction of the forest reserves in Uganda. About 1,000 km^2 (1 per cent) of natural forest were assessed to have been transformed into agricultural land between 1973 and 1986. Based on this information, the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) decided to conduct a more detailed study with the higher resolution LANDSAT TM data for Mt. Elgon central forest reserves.

II. OBJECTIVES

5. The objectives of the study were:

(a) To examine in detail a set of multi-data TM imagery in order to assess the extent and nature of agricultural encroachment and other types of related deforestation activities in Mt. Elgon central forest reserves;

(b) To develop a simple methodology for forest map update based on manual interpretation of satellite remote sensing data which is easy and cheaper

to use in the field (provincial and district level) where sophisticated computer systems may not be available;

(c) To estimate the amount of forest that has been removed in favour of crop cultivation or other activities based on 1962 and 1973 map and/or satellite information;

(d) To demonstrate the capability of LANDSAT TM data to provide sufficient information for revision of forest cover and up-date the 1:50,000 map scale.

6. The target area of the study is located in the Mt. Elgon central forest reserve between longitude/latitude, 34° 40', 34° 45' and 1° 06', 1° 37' respectively. This area lies just on the eastern border of Uganda with Kenya in Kapchorwa district as shown in fig. 1. It covers approximately 1,036 km^2 including part of the forest, the Moorland zone and the extensive grasslands on the northern side of the mountain. The reserve area, therefore, covered only 505 km^2. This forest occupies the humid ferrallitic soils of the high altitude, mostly suitable for growing wheat and maize crops. It receives an annual rainfall ranging between 1,780 mm and 1,650 mm.

7. With such fertile soils and favourable climate, the forest has long been subjected to population land pressure as could be assessed from the demographic information on the 1:50,000 topographical map (1962) which was used in the study. According to the map, there were approximately 1,270 homesteads countes within an average distance of 3 km from the boundary at the time of the aerial photography in 1959 (the compilation material for the above topographical map). The average settlement density was estimated to be 5 homesteads km^2 at the time. The minimum and maximum were 1 and 15 homesteads respectively.

III. DATA SOURCE AND MATERIALS

8. LANDSAT TM, black and white films (8 x 9) and colour transparency materials (scale 1:1,000,000) were purchased from EOSAT company (USA) and processed at the RCSSMRS laboratory. Mt. Elgon forest reserve was covered on LANDSAT TM scene 170/059 of 10 February 1986.

9. Two types of photographic printing materials were used in creating these colour prints, namely the normal cibachrome paper and cibachrome II translucent. The latter allows sufficient amount of light to pass through it even when underlain with a base map print. In addition, it was possible to draw on it with a felt pen or water soluble plotting ink.

10. One topographical map, scale 1:50,000 series Y732 sheet no. 55/1, Edition 1-U.S.D., was used as the data base. Other data source materials included: reference topographical maps at scales 1:50,000, 1:250,000 and 1:2,000,000. Similarly, vegetation and soil maps, together with the UNEP/GEMS/GRID (1987) computer printouts of the Uganda environmental data base land-use/land cover maps, were used. Field information was also collected and integrated with the image interpretation.

11. The cost of data and other working materials used in this project is given in table 1. The rates of photographic processing are those charged at the Centre. The cost of expert labour for the interpretation is not given because this may vary with individuals and country.

Table 1: Cost of data materials

Item	Description	Rate ($US)	Total ($US)
1.	Original B/W Positives (Full Scene)	150.00	480.00
2.	False Colour Generation (Enhancement)	40.00	40.00
3.	Subscene Print (Translucent 16" x 20" x 40")	33.00/ 97.00	97.00
4.	3 Reference Map Sheets (All scales)	3.00	9.00
5.	Transparency, one metre	6.00	6.00
6.	Miscellaneous	10.00	10.00
	Total		642.00

IV. METHODOLOGY

12. As indicated earlier in section II, the objective of this study was to develop a simple and easy method of using satellite remote sensing data to detect forest cover changes which are associated with agricultural encroachment and/or general deforestation activities and use these results to up-date 1:50,000 scale map. The analysis and interpretation of LANDSAT imagery was done manually using the overlay method to compare two sets of data, i.e., the old map with recent imagery. Valerie (1980) described the approach as old-map/new source change detection method which can be used in the land-use/land cover map up-dating process.

13. The two types of printing paper materials were compared and used selectively, based on the quality and contrast of the original image. The original TM imagery was enlarged and matched to the base map scale of 1:50,000. This was then overlain with the topographic map for direct change detection. The scale match of the TM imagery print with the 1:50,000 topographical map was quite excellent.

14. The separation process of Mt. Elgon forest was based on spectral pattern signature as defined by colour tone (or colour shade), texture and shape . By using a light table and overlying the 1:50,000 scale topographical map of 1962 with the cibachrome II translucent print, the forest change was easily detected and discerned directly on the transparency. This permitted direct comparison of the 1962 old map with the new 1986 TM imagery. Seven land cover categories were discriminated within the forest boundary as shown in fig. 2 and table 3.

Each category was coded and the areas measured with a digital planimeter. The area change percentage was then calculated for each category as in table 3. Again each category area was measured, based on sub-county level, in order to relate the encroachment trends to the administrative boundaries. The results are given in table 5. In addition, the maximum and minimum distance of encroachment from the 1959 forest baseline was determined with a map measurer to locate where the deepest incursion occurred. The results are shown in table 4.

V. RESULTS AND DISCUSSION

15. The interpretation results yielded interesting information on the forest cover change and the extent of agricultural encroachment. In 1962, 1:50,000 scale maps was updated for forest cover using the LANDSAT TM colour image as shown in fig. 3.

16. The results obtained from the detailed analysis of LANDSAT TM image of the Mt. Elgon forest reserve are presented in tables 1, 2 and 3. Seven categories of cover types were identified and discerned as illustrated in Fig. 2. Based on the 1962 topographical map, 8,671 ha (27.4 per cent) of the forest land were encroached and totally replaced by agriculture in a period of 27 years. This is again supported by the fact that human population pressure on Mt. Elgon forest was recognized by the authority in 1983 (UNEP 1988) when 7,200 ha of forest land were officially degazetted in this reserve for settlement of people. The degazetted forest area was indicated on the map used in this study but the encroachment extended far beyond the marked boundaries according to the satellite imagery.

17. The soft wood plantation (category II) of 1,522 ha was established on the forest land as a replacement. This accounted for another 3.7 per cent of the removed natural forest.

Table 2: Deforestation trends in Mt. Elgon forest reserve area (ha)

Category	Description	1959	1986	% change
I.	Undisturbed natural forest	30,206	20.807	-46.9
II.	Soft wood plantation	56	1,522	+2617.8
III.	Moderately degraded	-	5,844	-
IV.	Severely degraded forest	-	2,418	-
V.	Forest totally replaced by agriculture	-	8,671	(27.4)
IV.	Moorland and heath	-	11,300	-

Table 3: Changes in the forest perimeter and encroachment distance on Mt. Elgon forest

Distance (km)

Item	Description	1959	1986	% Change
1.	Peripheral forest boundary	64	90	+40
2.	Maximum distance of encroachment	-	7	-
3.	Minimum distance of encroachment	-	1.4	-

Table 4: Deforestation trends in Mt. Elgon by sub-country categories - area in hectares

Sub-country	I	II	III	IV	V	Total
Bent	5,582	488	2,403	2,033	4,093	14,599
Chesoweri	3,103	110	598	-	583	4,394
Kabey	3,330	-	1,553	385	950	6,223
Chepkwasata	7,253	711	1,285	-	2,950	13,199
Kirwoko	733	-	-	-	-	733
Kapteret	513	-	-	-	-	513
Tigeres	18	-	-	-	-	18
Chema	275	-	-	-	-	275
Tulel	-	-	-	-	85	85
Kanyiyi	-	213	-	-	10	223
Total	20,307	1,522	5,844	2,418	8,671	39,262

18. The reforestation and crop cultivation together accounted for 25.9 per cent of the deforestation during the period of 27 years.

19. The information in table 3 confirms the change in the length of boundary of the forest from 64 to 90 km - a positive increase of 40 per cent. It also provides information on the maximum and minimum distance of clearing into the forest from the 1959 baseline. The longest distance of clearing into the forest was 7 km in Benet sub-county while, the shortest recorded was 1.4 km in Chepkwasata, Kono and again Benet sub-counties. This encroachment distance can also be used as a yardstick to locate spots where population pressure might be concentrating.

20. In summary, the agricultural encroachment (27.4 per cent) and reforestation (3.7 per cent) accounted for 31.1 per cent of the decline of the natural forest in the study area between 1959 and 1986. This figure is, however, very conservative, because it does not take into account the proportion of the cleared forest land in categories III and IV. For instance, the net deforested land in category III (severely degraded forest) was estimated to be 50 per cent. The results in table 4 show the forest in Benet sub-county to have suffered most with 4,093 ha (10.4 per cent) of forest land lost to agriculture. In other words, there was 20,807 ha (53.1 per cent) of "undisturbed" natural forest in 1986 as compared to 39,206 ha in 1959. Again, Benet sub-county was still leading in the severely degraded and moderately degraded forest by 2,403 ha and 2,033 ha respectively. Based on the 1959 baseline data, the negative forest change of 46.9 per cent (table 3) represents 18,399 ha of the natural forest which was destroyed.

VI. CONCLUSION

21. The results of this study have proved beyond doubt the potential for LANDSAT TM sensor system to provide useful information for detecting agricultural encroachment and deforestation in the montane forests.

22. The 30 m resolution TM data provided detailed information on Mt. Elgon forest and permitted a better insight into the forest. At a magnification of 1:50,000, cropped areas which are one hectare or more, could be detected although not measurable with a digital planimeter. This is an important characteristic of TM, because small plots of cultivation can be recognized in the forest (due to the strong contrast between the forest and bare soil). A dry season image is the best choice for identifying small parcels of cultivation in the forest on a TM image. The large consolidated areas of season crops (e.g., category V) like maize and wheat, which get dry during the dry season, were easy to recognize as a spectral pattern.

23. Monitoring of the forest cover changes and up-dating such information on 1:50,000 scale maps can be achieved in a time and cost effective manner by deploying multi-data LANDSAT TM imagery. The new encroachment line can be established by interpreting up-dated satellite information and producing current change maps. Such maps can be generated at selected intervals of one or two years within a minimum time of three months. The current operational LANDSAT 5 is capable of acquiring multi-data images over the same area frame every 16 days. Similarly, SPOT satellite can provide data at intervals of 27 days or less. A follow-up on this work is recommended in order to take advantage of this new technology and develop a monitoring system based on space data which can be acquired at programmed intervals.

24. Once these changes are defined, they can be transferred to the old maps by matching the image scale and use the cibachrome II translucent to print the enlarged imagery. This material allows direct transfer of the new information on to the old map or the corresponding map overlay. The method developed can be used to update the forest cover on 1:50,000 scale maps in a minimum time of one month per sheet given the satellite data.

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USE OF DOPPLER POSITIONING METHOD IN CADASTRAL SURVEYS AND BOUNDARY DEMARCATIONS

By

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RCSSMRS

I. INTRODUCTION

1. All over Africa there is a feeling of urgency in coping with the tempo of development taking place. There is the urgency to increase food production to cope with increase in population. There is the urgency to increase industrial production to cope with the demand of consumer industrial products.

2. In the heat of this kind of urgency many investors are acquiring parcels of land either as agricultural and/or industrial plots.

3. These many parcels of land need to be surveyed before legalization of acquisition can be effected.

4. New settlements are being set up in Africa and these settlements need to be surveyed so that title deeds can be obtained. These title deeds may serve as security for financiers or the survey plans can be used for planning purposes.

II. THE PROBLEM OF POOR SURVEY CONTROL COVERAGE

5. In general, Africa is very poorly covered by survey control. This shortage has created a chain of other related problems such as delays in survey work, delays in production of maps and delays in implementing other development projects such as agricultural projects and establishment of road networks.

6. In case of agricultural projects the survey work may be useful when finances are to be borrowed from financial institutions which require a title certificate (deed) as security before granting loans. In a poorly controlled area it may take a long time before the survey party can connect the survey work of the area to the national grid, a requirement which must often be met before the cadastral work is approved.

III. THE PROBLEMS OF SURVEY EQUIPMENT AND SURVEY METHODS

7. Due to high prices of modern survey equipment, most survey departments are still equipped with the old conventional survey equipment. In most cases the main field equipment would comprise the theodolite, an EDM equipment and the level. This equipment is ideal for small-scale surveys where using more expensive equipment would not be recommended.

8. However, for large-scale surveys, such as those of ranches and big farms, the use of the conventional survey equipment is time-consuming and very labour-intensive.

IV. THE USE OF DOPPLER RECEIVERS AND OTHER MODERN SURVEY EQUIPMENT

9. The introduction of the Doppler and the Global Satellite System (GPS) receivers in the survey field was a big relief to those involved in the profession.

10. The equipment is not weather dependent (in most cases), intervisibility between sets in not necessary and the operation is simple. So there is a great cut down in field expenses, manpower and time. It can be shown (Hoar, G.J.) that using the Doppler receiver instead of the conventional equipment in fixing control points there is a gain in time of about 70 per cent and a financial saving of up to 50 per cent. With the GPS sets there should be even a bigger gain.

11. In terms of accuracy, with the Doppler sets being operated in the translocation mode, the horizontal position accuracy achievable can be as good as 10.5 metres (1 sigma) for 17 acceptable passes common at each station (Hoar, G.J.). With baselines of 10-15 km, relative accuracy better than 1/10,000 can easily be achieved. The GPS sets can provide proportional 3-D positional accuracies of from 10 ppm to 1 ppm (Cain, J.D.).

V. EXPERIENCES AT RCSSMRS IN USING DOPPLER POSITIONING TECHNIQUE IN CADASTRAL SURVEYS

12. The Regional Centre for Services in Surveying, Mapping and Remote Sensing, Nairobi, Kenya, has conducted Doppler surveys in Mtwara and Arusha in the United Republic of Tanzania. The established control was intended to assist in the demarcation of village boundaries so that the villages could obtain titles (certificates of occupancy) to enable them to obtain loans from financial institutions. The control points could also be used for other surveys required for other surveys required for other development projects.

13. The projects have all been a success since about 100 points were fixed in Mtwara in a field-period of nine months and about 30 points in Arusha within a field period of three months. If conventional methods were used, each of the projects should have taken a number of years to complete.

VI. THE PROBLEM AND SOLUTION OF THE HIGH COST OF MODERN EQUIPMENT

14. The high cost of the Doppler and GPS receivers has been the main hindrance to most survey departments in acquiring the equipment.

15. Furthermore, most departments argue that the use of the equipment is quite limited after the densification exercise. However, this argument is now losing ground as these departments start establishing their Geographical Information Systems (GIS) where GPS receivers are very handy in acquiring the required field data.

16. One solution to the problem of high cost of the equipment can be reached through regional co-operation. Simply put, this means that such equipment can be purchased by contributions from a number of countries or institutions and a programme worked out so that the equipment can be rotated among the member countries when needed. This has been achieved in the case of the contributing member countries at RCSSMRS where the Doppler receivers can be used in about 22 countries. Other regions in Africa could establish such regional co-operation agreements or use the existing regional scientific centres as co-ordinating centres.

17. This is not a new concept as this mode of co-operation is clearly spelt out and emphasized in the Lagos Plan of Action for the Economic Development of Africa.

VII. SUMMARY

18. There is a very high demand of cadastral surveys in Africa due to the high rate of development all over the continent.

19. To cope with this high demand of cadastral surveys, survey departments are encouraged to adopt modern methods and equipment to supplement the conventional ones. The use of Doppler (or GPS) receivers in establishing control for the demarcation of cadastral boundaries has proved very cost-effective and time saving.

20. The problem of high cost of modern equipment can be solved through the establishment of regional co-operation agreements where resources can be pooled together to acquire such equipment.

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THE ROLE OF THE REGIONAL CENTRE FOR SERVICES IN SURVEYING, MAPPING AND REMOTE SENSING IN REMOTE SENSING TECHNOLOGY TRANSFER IN EASTERN AND SOUTHERN AFRICA

by
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A B S T R A C T

The role of the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in remote sensing technology transfer has been increased and enhanced in the Eastern and Southern African subregion through the three programme areas, namely training, project execution and provision of remote sensing data user assistance services.

A significant contribution to the technology transfer programme has been provided through training in the form of short-term and extended courses as well as on-the-job training. To date, more than 1,000 participants have been trained at the Centre.

The three programme areas continue to be supported by an excellent black-and-white and colour photo laboratory complex for processing Landsat and SPOT images. The Centre has continued to increase its imagery acquisition providing an extensive range of imagery collection.

Analogue techniques of data analysis are being augmented by digital methods for the data obtained by Landsat,SPOT and Meteosat.

Examples of projects completed using satellite remote sensing data have been cited and discussions on bottlenecks and problems of remote sensing technology transfer examined in light of the Centre's experience.

I. INTRODUCTION

1. The Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), Nairobi, Kenya, has been able to play its role in remote sensing technology transfer since the establishment of the remote sensing facility in 1977. It has been able to do so largely through its comprehensive training programme, significant contribution in project execution and provision of remote sensing data user assistance services. RCSSMRS realizes that there are fundamental difficulties and adjustments inherent in remote sensing technology transfer which need to be addressed in order to achieve the desired results in Eastern and Southern African subregion.

2. The goals and objectives of remote sensing technology transfer continue to be complex due to the dynamic nature of the technology in developed countries. They are well placed to forge further ahead, given the technological advancement in developing new remote sensing techniques whose target is the developing countries. This phenomenon renders the developing countries to be on the receiving end of remote sensing technology.

3. Developing countries require up-to-date and accurate information on their natural resource base on which to base sound and rational decisions. Each

country has got priorities ranging from emergency needs to long-term commitments of resources assessment such as resource inventory and information systems. Resources base information in developing countries is lacking due to several reasons. The most common reasons are lack of trained personnel, equipment or funds to generate the information and inaccessibility of some regions because of poor communications. The resource base in these countries undergoes fast changes such as high rates of deforestation, rapid soil and environmental degradation from changes in land use due to disproportionate increase of population pressure. Remote sensing technology has proved to be one of the techniques that developing countries could use in the development of their data base information systems.

4. Due to the importance of remote sensing, a number of technology transfer programmes by aid-giving agencies have been initiated. These have been both at bilateral and multilateral as well as national and regional levels. The strategies for remote sensing technology transfer have evolved during the past 15 years and have included training of third world scientists in institutions of developed countries, project or equipment, grants for remote sensing demonstration projects in these countries and support for the establishment of national as well as regional remote sensing centres (Conitz, 1977 and Wagner, 1980). The United States Agency for International Development (USAID) has had a number of technology transfer programmes that have included remote sensing centres. RCSSMRS has well-established remote sensing activities at the initiative of USAID (Conitz 1981). This paper discusses the efforts of the Centre in remote sensing technology transfer and points out the bottlenecks that make it difficult for rapid achievement of desired results.

II. TRAINING

5. Training remains the most important means of remote sensing technology transfer that the Centre has used in Eastern and Southern African subregion. To date, more than 1,000 participants have been trained in various disciplines.

6. RCSSMRS runs three types of courses which include three-week short courses, extended courses as well as on-the-job training. The courses are discipline-specific as well as practically oriented to the professional needs of the participants (Odenyo, 1984). Recently, the Centre has been able to accept internship from various institutions in Kenya. The interest and results have been encouraging.

7. The short courses consist of one week of introduction to remote sensing, several field trips to correlate imagery and surface conditions, one week of discipline-specific applications and participant preparation of a proposal for a remote sensing project. The participants are provided with imagery of areas of interest. To date, the Centre has developed a series of training aids, field trips and classroom exercises courses.

8. Extended courses have proved popular since their introduction in 1982. The objectives of the extended courses are to provide greater exposure of participants to remote sensing and link the Centre to ongoing resource development projects in the subregion. These courses begin with two to three

weeks of classroom sessions in Nairobi. During this period, the participants define a project using remote sensing techniques to be conducted over several months in their home institutions. This project should be part of their normal employment activity. During the implementation of these projects, the Centre provides imagery, consultations in the field and other assistance as necessary and reasonable. The participants return to Nairobi for a one-week reporting period.

9. There is an increasing number of requests for intership training from some institutions in Kenya. Participants are normally final year students who require practical knowledge in remote sensing. Within three to four months, the participants complete a study in remote sensing guided by remote sensing staff. The participants are able to use the facilities at the Centre and are assisted in some ways with imagery and ground truthing.

III. USER SERVICES

10. RCSSMRS provides a range of services in assisting users of remote sensing techniques in the subregion. The most frequent activity is the processing of imagery orders and responding to main and personal inquiries on data availability, costs of obtaining imagery or possible application of remote sensing to specific problems.

11. A number of annotated brochures have been printed to provide information on the Centre and its activities. These materials have been prepared to meet the popular demand by the participants.

12. RCSSMRS receives group tours from institutions in Kenya as well as other countries. The frequency of such tours point to the increasing awareness of remote sensing technology.

IV. PROJECTS

13. RCSSMRS continues to be involved in a wide range of projects in the subregion. The projects are in response to requests from users. The requests have their origin in the training courses, information seminars and information brochures disseminated around the subregion by various means. More bilateral projects have been negotiated and implemented.

14. In most cases, the project activities are generally initiated by the recipient organization and the Centre provides imagery and consultation and may assist in obtaining of outside consultants when appropriate. The projects have been designed in such a way that the actual analysis is done by the staff of the initiating organization after being trained by RCSSMRS in remote sensing techniques. The Centre continues to coach and supervise them during the project implementation. This approach assures the initiating organization of two results, namely a usable product and staff members trained to apply remote sensing techniques in a particular problem area.

15. By 1984, the following projects were completed or about to be completed:

(a) A vegetation cover map of the United Republic of Tanzania using Landsat imagery at scale of 1:2 million and consisting of 12 level II classes and several sub-classes;

(b) A reconaissance soils map and an agricultural capability map were prepared by the soil survey unit of the Ministry of Agriculture, Government of Zambia for the North Western Province of Zambia;

(c) A survey of the forests in Kenya and an evaluation of rates of forest depletion. The study mapped 270 individual forests with a total forest cover of 1,167,180 ha or plantations and mangrove (Ochanda, 1982);

(d) A forest resources inventory for the Sudan using the Centre's Landsat imagery and equipment was completed in 1983;

(e) The Centre has been involved in many cartographic projects at various scales. Most of them are experimental seeking the approval of member countries.

16. Additional projects since 1984 include the following:

(a) SERISS project which attempted to forecast agricultural yields in the provinces of Darfur and Kordofan in the Sudan was completed in May 1988 and a final report presented to the Government of the Sudan;

(b) A Lesotho image map was recently completed and dispatched by the Overseas Ordinance Survey;

(c) A Dar-es-Salaam vegetation cover map is ready for printing. The map has been compiled at scale of 1;250,000 from Landsat data held at the Centre;

(d) A resources and environment project was completed for Uganda in 1988. The project was jointly executed by UNEP and the Regional Centre (UNEP, 1988).

V. DISCUSSIONS

17. Remote sensing technology transfer has been accepted to be the status quo between developed and developing countries. There is a constant flow of sophisticated equipment being developed with a view of finding market in developed countries. Since these equipment and techniques are developed far away from the areas where they a to be applied, there is always a gap of the real problems to be addressed.

18. Developing countries have no choice but to be on the receiving end in this game of technological development. Developed countries have ample financial resources which make it easy for them to be leaders in remote sensing

development. Many natural resources scientists in the Eastern and Southern African subregion feel that the high cost and lack of funds for acquisition of data and equipment have greatly contributed to the slow pace of remote sensing technology transfer.

19. Remote sensing technology is rapidly gaining popularity in a number of developing countries. Many countries have established national remote sensing centres through which the technology can be transferred. These centres have yet to be given adequate budgetary resources in order to have a realistic impact in the activities they undertake.

20. RCSSMRS considers institutional building to be a fundamental step in achieving the goals and objectives of remote sensing technology transfer. It is through these institutions that a large number of natural resources scientists will be exposed to remote sensing. The more the trained manpower, the faster the adoption of remote sensing technology.

21. Human population is rapidly increasing in many developing countries faster than the provision of adequate resources for their upkeep. It is with this in mind that rapid, accurate and cheap methods of resource data base information acquisition should be encouraged. Remote sensing technology is being developed to meet these requirements.

22. Associated with population increase is the provision of adequate educational facilities to cater for various technological advancements. The Centre has encouraged both university and college participants to take the study of remote sensing seriously. To date, three of the universities in Kenya have started remote sensing units in their course. One polytechnic college in Nairobi regularly requires its students in the environmental studies section to go through remote sensing internship at the Centre. We believe that in addition to adequate funds large numbers of scientists in remote sensing will bring about the success of remote sensing technology transfer.

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REPAIR AND CALIBRATION OF SURVEY INSTRUMENTS IN THE EASTERN AND SOUTHERN AFRICAN SUBREGION

by

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RCSSMRS

I. INTRODUCTION

1. The Regional Centre for Services in Surveying, Mapping and Remote Sensing, as part of its main objectives, carries out repairs and calibration of theodolities, levels, photogrammetric plotters, distance measuring instruments and other surveying instruments for the member States of the Eastern and Southern African subregion. Over and above this the Centre conducts training programmes in the repair and calibration of these instruments to enable nationals of member States to gain sufficient knowledge and practical skills to be able to look after their own instruments.

2. Over the years, almost all countries in the region have acquired a lot of survey instruments through either donor technical assistance or direct purchase from the manufacturers. At the time of acquiring these instruments, the manufacturers were prepared to offer regular after-sale service or even attend to break down problems. Gradually, this trend changed to the present case where manufacturers are no longer willing to provide this essential service.

3. Consequently, in many countries, either fairly new instruments are written-off for lack of service and maintenance facilities within the country or a lot of the scarce foreign exchange is spent to either send the instruments abroad for repair or bring maintenance technicians from overseas. Either way, the debilitating financial situation that is already prevalent in the subregion is only made worse.

II. SERVICES OFFERED BY THE REGIONAL CENTRE FOR SERVICES IN SURVEYING, MAPPING AND REMOTE SENSING

A. Repair and maintenance services

4. Having recognized the above situation, RCSSMRS established the repair and maintenance service for its member States in 1979. Over the last nine years, more than 8,000 pieces of instruments have been serviced in the Eastern and Southern Africa subregion. Not only has this meant a lot of savings on the financial resources of the member States, it has also meant that projects that required these instruments have been able to continue.

5. The task of meeting the service requirements of such a diverse subregion has not progressed without any hitches. For various reasons, the subregion has a diverse collection of survey equipment from different manufacturers such as Wild, Kern, Zeiss, MOM, Bilger-Watts, Sokissha, just to mention a few.

6. The engineering department of the Centre has the capacity to repair and calibrate all these makes of instruments based on the factory training that the staff have obtained from the three main suppliers: Kern, Wild, and Zeiss.

7. In general therefore, the repair and calibration of some makes of instruments is dependent on the availability of appropriate service manuals and spare parts. There have been cases where manufacturers have not co-operated in the provision of spare parts and service manuals. In such cases, the Centre can do nothing but return the instrument to either the owners or forward it to the manufacturers on their behalf.

8. In cases where service manuals and spare parts are available, the Centre has no service problems whatsoever. It does however take time to procure the required spares as they have to be ordered directly from the factories. It may be necessary

at some stage, depending on the availability of funds, to stock those parts that get changed regularly for the purposes of increasing the instrument availability time and minimizing the mean time between failures (MTBF).

9. In addition to servicing of surveying instruments, the Centre having recognized the lack of back-up technical service for map processing and printing equipments in the region, has diversified its capability to cover these. Here again since there are a lot of different manufacturers of these instruments, each one is repaired and calibrated dependent on the availability of service manuals and spare parts. At the moment, none of the staff has been specifically trained on any of these instruments and therefore the amount of assistance the Centre can offer in this area is limited.

10. The list of equipment from the different manufacturers that the Centre is competent to repair and calibrate is shown in the annex to this paper.

B. Training in the repair and calibration of survey instruments

11. The Centre has a two-level maintenance policy in the repair and maintenance of survey equipment as follows:

(a) Level 1: At this level the basic cleaning, adjusting and the detection and correction of minor faults is performed monthly or longer interval depending upon the use of the instrument and conditions of storage;

(b) Level 2: Here the instrument is dismantled, all parts are cleaned/polished and greased as necessary, worn-out parts replaced, reassembled and calibrated accordingly. This being a comprehensive service, it is only necessary every two years or so, again depending upon use and local environmental conditions (coastal and desert areas may require this service on an annual basis).

12. Considering the 'catchment' area of the Centre, it is not possible to send a service team to every country more than once a year. For this reason, it is essential to establish a team of service personnel in each country who perform the level 1 service on a regular basis on all the country's equipment. In this way, instruments will be in use most of the time rather than on the shelf waiting for the Centre's service team to attend to them.

13. For this reason, training in the repair and calibration of survey instruments for level 1 is given high priority within the Centre's training programme.

14. A one-to-one practical training programme is arranged for participants on any pre-selected instruments. This, unlike the factory training where an individual follows book instructions, provides the individual not only with the required knowledge and practical skills but also encourage the rare "personal touch" of sharing experiences. The staff have years of practical experience in this job, initially obtained from the instrument factories and further complemented by the variety of instruments they have to repair and calibrate each year.

15. One of the problem areas here is the retention of the practical skills acquired. It is a known fact that unless one practises these skills regularly, it will not be possible for one to remember all the intricate service details when required. In most organizations, because of limited number of instruments, it is not possible to practise these skills on a regular basis, hence the effectiveness

of their trained service personnel becomes limited. This is one of the reasons for emphasizing the training for level 1 which needs to be done on a regular basis.

16. It is also essential for the Centre to have contact persons within organizations for the purposes of getting details of faults on instruments when they occur so that appropriate spares may be obtained in advance.

17. Since the technology is continuously changing, it is an essential pre-requisite for a good maintenance policy to re-train its personnel on a regular basis even if on the same instrument depending on the amount of exposure to that instrument.

18. In this way, the individual countries with such instruments shall help the Centre in its untiring efforts to repair and calibrate the instruments in the Eastern and Southern African subregion.

III. CONCLUSIONS

19. It is a fact that most countries in the subregion cannot afford to replace their survey instruments due to limited financial resources. This being the case, it is necessary to adopt a good maintenance schedule for the purpose of extending the life expectancy of the instruments and to train national personnel in the repair and calibration of these instruments. This will guarantee that the instruments will be fully utilized thereby getting the most out of them.

20. It is a known fact that the repair and calibration services that the Centre is offering to its member States is the only one of its kind in the subregion. The financial savings that accrue from such services is immense.

21. For the purpose of having a good maintenance policy for these special instruments, it is highly recommended that each organization identifies a few technical staff for training at the Centre in the care and maintenance of the instruments.

ANNEX

INSTRUMENTS AND EQUIPMENTS SERVICED BY THE CENTRE

(a) OPTICAL INSTRUMENTS

Wild Levels:	NAO, NAKO NAK1, NA2, NAK2, NO1, NK01, NO5, N1, NK1, N2, and N3.
Wild Theodolites:	TO5, TO, T1, T16, T2, T3, T4 and RDS.
Wild Photogrammetric Equipment:	B8, B8S, A9, A7, A10, VG1, PUG3, PUG4, TSP1, ST4.
Wild Miscellaneous Equipment:	RK1, ZBL, ZL, NL, GDP3, DF6, TMO, Tripods, etc.
Kern Levels:	CKO, CKOA, GK1, GK1-A, GK2A and GK23,
Kern Theodolites:	KIS, KIA, DKM1, DKM2, DKM2A, KOS and KIRA.
Kern Theodolites: Equipment.	Tripods, Tribrachs, etc.
Zeiss Levels:	NI1, NI2, NI4, N42 and NI62.
Zeiss Theodolites:	TH2, TH42, and TH51.
Zeiss Miscellaneous: Equipment:	Tripods, Tribrachs, etc.
Other Makes:	Watts, Nikon, Sokissha, etc., can also be serviced and repaired when spares are available.

(b) ELECTRONIC INSTRUMENTS

Wild:	DI10, D13, D13s, D14, D14P D120. Supper Bettle and Citation, RC8, RC10, RC10A and NF2, EKS, EK20 and EK
Kern:	DM101, DM500, DM501, DM502, DM503 and DM200C.
Zeiss:	ELD11, ELD12, ELD13 and ELD14, SM1, SM2, SM3 and SM4, ELTA1, ELTA2, ELTA3 and ELTA4.

AGA	AGA110, 112, 14A, 120, 116, 6A and 6B.
Other Makes:	Where spares and service manuals are available most electronic equipment can be serviced at the Centre.

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MODERN TRENDS IN MAPPING

by

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RCSSMRS

Abstract

The current technological advancement has brought with it new methods, new equipment and data that can be used in the process of map production.

The development of earth resources technology satellites as well as transit satellites for satellite positioning techniques using Doppler receiver and GPS surveying equipment now produce accurate control surveys for map production in a short period of time and for less cost as compared to the conventional methods of providing such controls. The availability of satellite imagery of high resolution has made map revision quicker and cheaper than ever before. All these new methods of surveying, aerial photography and photogrammetry have brought about new trends in mapping.

The Regional Centre for Services in Surveying, Mapping and Remote Sensing has implemented several mapping projects using these new methods and has also been conducting courses on these new developments in mapping. One such course which has been very popular is "Modern Trends in Mapping". The course was developed for professionals and technicians involved in map production. In this paper, the contents of the course are discussed and the details of the projects carried out are highlighted. Various outputs so far achieved are listed and evaluated.

I. INTRODUCTION

1. The last two decades have been significant and important technical developments in the whole field of cartographic production embracing geodesy, photogrammetry, cartography, reproduction and printing techniques. This has naturally affected map production methods as well as cost of production of the maps.

2. The introduction of remote sensing technology as a tool for data collection for the compilation and revision of topographical and thematic maps, coupled with the improvement in computer technology for automated mapping, opened new doors to the map production process. However, only a few of the mapping organizations in Africa are able to afford to use the new technologies of remote sensing and automated cartography.

3. Cartography training in the public educational establishments is not yet completely satisfactory because students of cartography at ordinary diploma and first degree level are given sufficient training only in cartography and land surveying, but very little or nothing in remote sensing and automated cartography. Consequently, therefore, the short courses being offered by Geodesy and Aerial Photography and Cartography Departments at RCSSMRS become useful and timely because they have been introduced at the time when some African Governments cannot afford to send their technicians and professionals to overseas institutions to up-date their technical/professional skills.

II. DEVELOPMENT OF THE COURSES

4. During the third Programming Cycle (1982-1986), the International Union of Geodesy and Geophysics (IUGG) and the International Association of Geodesy (IAG) together with the African Association of Cartography approved the African Doppler Survey (ADOS) Project to cover the whole of Africa with Doppler points. The Regional Centre was the executing agency for the project. During the same period 1982-1986, the International Development Research Centre (IDRC) of Canada also funded a Satellite Data Photomapping Project. One important objective contained in the two projects was to design methodologies to be used in achieving results and disseminating these results to other mapping professionals and technicians through training within the Eastern and Southern African subregion. It was the development of these new methodologies and techniques which were put together in the form of training package entitled "Modern Trends in Surveying and Mapping".

A. Modern trends in surveying and mapping

5. In 1984, the Geodesy and Aerial Photography Department gave a training course in Mbabane, Swaziland. The purpose of the course was to provide a forum at which practising surveying technicians could meet and exchange experience through practical techniques in order to up-date their professional knowledge. The same course was mounted again in 1986 in Lusaka, Zambia and in 1987 in Lilongwe, Malawi. During these two courses, the Cartography Department of RCSSMRS was invited to present a short seminar on the methodologies developed and results achieved from the research being carried out in the development of techniques for the use of satellite data in the production and revision of topographical and thematic maps.

6. During the two courses the following were discussed:

(a) Introduction to electromagnetic distance-measuring methods;

(b) Establishment of calibration baselines;

(c) Calibration equipment;

(d) Review of Doppler surveying methods;

(e) Electronic theodolites, total stations;

(f) Review of the electronic computing techniques in surveying and mapping using pocket calculators, microcomputers and mainframe computers;

(g) Data management and land information systems;

(h) Digital cartography;

(i) Satellite data photomapping, including maps revision using various techniques;

(j) Photogrammetry for cadastral and control surveying, topographical surveying technique;

(k) The role of the Regional Centre in interregional geodetic surveying projects: Ados Project, AGSN Project and Network Adjustment and Analysis in the subregion.

B. Modern trends in mapping

7. In 1985, the Cartography Department which had by this time started achieving results from the research into the use of satellite data in production of photo maps designed and conducted

a short course entitled "Photomapping using satellite data". Participants at this course were cartographers who were already trained in polytechnics and colleges of technology and already employed in mapping organizations.

8. They were trained in the aspects of the use of satellite imagery/aerial photographs in the revision/production of topographical and thematic maps.

9. The course contents were;

(a) Introduction to remote sensing;

(b) Introduction to electromagnetic spectrum;

(c) Satellite operational parameters;

(d) The use of satellite data for photomapping;

(e) Colour compositing, mosaicking of imagery, image density control;

(f) Densitometry, sensitometry, satellite image quality control;

(g) Characteristic courses;

(h) Colour separation, half toning;

(i) Review of map projection, map projections system used in surveying and mapping in the Eastern and Southern Africa subregion;

(j) Control for mapping, establishment of horizontal control, the Doppler survey methods;

(k) Compilation of planimetric details from satellite imagery;

(l) Scribing of planimetric details, combining of planimetric details with satellite imagery; and

(m) Cromalin proofing and lithographic press printing.

10. As the two courses developed, it became clear that some of the new skills being acquired by both the surveyors and cartographers were common. It was in the light of this that the titles of the two courses were changed to "Modern Trends in Mapping".

11. The following table shows the attendance at the courses given by both Cartography and Geodesy and Aerial Photography Departments from 1984 to 1989.

TABLE OF ATTENDANCE AT THE COURSES

Country	1984		1985		1986		1987		1988		1989	
	GAP	CD	GAP	CD	GAP	CD	GAP	CD	GAP	CD	GAP	CD
Botswana					2		2					
Burundi												
Ethiopia			1	1								
Ghana			2									
Kanya	6		2	8	3			7		6		1
Liberia			2									
Lesotho	4											
Libyan Arab Jamahiriya	1											
Malawi	1		2		3		13					
Mauritius												
Madagascar												
Mozambique	1		2		1							
Nigeria			1									
Rwanda												
Somalia												
Sudan			1	2								
Swaziland	12				3		3					
United Republic of Tanzania	5		2	6	9			4		4		1
Uganda	5		2	3	4			2				1
Zambia					12		3					
Zimbabwe	1		1	1	1		1					
Zanzibar												
163	35		42		38		35		10		3	

GAP = Geodesy and Aerial Photography Department
CD = Cartography Department

C. Course Evaluation

12. It is the policy of the Regional Centre to evaluate each and every course that is held at the Centre. This way it enables the course co-ordinator and indeed the Centre's management to find out whether the course has achieved the objectives for which it was planned and designed. This is done by course participants themselves who complete confidential course evaluation questionnaire. The following questions were answered by each participant:

(a) What is your general impression about the course;

(b) What was the level of your knowledge of the topics covered before the course and after the course;

(c) To what extent is the course relevant to the needs of your occupation;

(d) What is your view about the length of the course;

(e) Was the general organization of the course good or not;

(f) What was the level of teaching including practical and theory;

(g) Were the demonstration facilities adequate or not; and

(h) Comment on every item of topics discussed during the course.

13. The summary of all the answers in the questionnaire was used to review and improve on the general organization and the contents of the course on Modern Trends in Mapping thus making it very popular among professionals and technicians in the map production organizations in the Eastern and Southern African subregion.

D. Course fee

14. Until 1988, a good number of courses at the Regional Centre for Services in Surveying, Mapping and Remote Sensing were sponsored by international and donor organizations and so the courses attracted large number of participants as can be seen from the table of attendants. Since 1988, the Centre has adopted a new policy of revenue generation in order to attain a level of self-sufficiency. The course on Modern Trends in Mapping therefore now attracts a fee of $US 1,500 excluding pocket allowance, hotel accommodation and other emergencies. This however has affected

course participation. Nevertheless, efforts are being made by the Centre and participants own governments to secure sponsorship for individual participants' who qualify to attend the course at the Centre.

III. CONCLUSION

15. The development of short training courses at the Regional Centre for Services in Surveying, Mapping and Remote Sensing provide answer to one of the objectives for which the Centre was established. From what has been presented above, it is clear that member States in the Eastern and Southern African subregion have benefited from the course on Modern Trends in Mapping organized by the Centre. It is strongly felt that member States from other subregions should also take advantage of this training course in Nairobi.

16. Once the necessary equipment are available, individual countries can request the Regional Centre to mount the courses in their home areas or they can send their trainees to courses specifically designed for them.

17. Experience has so far shown that donors and international organizations are very willing to provide funding for these training courses held in the subregion where large numbers of participants can have the opportunity of benefitting. Thus, member States are urged to contact donor countries and international organizations to provide financial support for their participants to attend these courses at the Regional Centre for Services in Surveying, Mapping and Remote Sensing in Nairobi.

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REGIONAL MACHINERY FOR THE CO ORDINATION OF LINGUISTIC DIVISIONS OF THE UNITED NATIONS CONFERENCE ON THE STANDARDIZATION OF GEOGRAPHICAL NAMES

(Secretariat)

BACKGROUND

1. The Economic and Social Council of the United Nations recommended that a United Nations Regional Cartographic Conference for Africa be convened to deal specifically with cartographic issues pertaining to Africa. The present Conference is the seventh. It will be recalled that the first Conference was held in 1963 at a time many African States had just attained independence. Since that Conference, many country reports have reflected advances made in infrastructure development and successes scored in extending the field of area covered by topographical maps at various scales. There has been a dramatic change in the character of resolutions adopted reflecting more on development issues. These development issues include the establishment of co operative projects and programmes such as the setting up of regional Centres for services and training in surveying and mapping as well as user assistance Centres for remote sensing and, lately an organization with a co-ordinating role for the advancement of cartography and remote sensing in Africa. Primarily the activities of the United Nations Economic Commission for Africa (ECA) go beyond propagation of the science and technology of cartography and aim at addressing issues of socio economic development for a better life for all.

2. Beside the United Nations Regional Cartographic Conferences (for Asia and the Pacific, Africa and Americas) the United Nations convenes the meetings of the United Nations Group of Experts on Geographical Names (UNGEGN), then the United Nations Conference of the Standardization of Geographical Names. The Conference and the Group of Experts deal with geographical names and their functions though distinct, they aim at obtaining standardized names through proven methods and guidelines to national geographical names authorities. It is established that the Conference as well as the Group of Experts should reach national committees or authorities through Linguistic Divisions. Africa is divided into: Africa Central Division, Africa East Division, Africa West Division and the following countries come under the Arabic Division that comprise Arab speaking countries of the middle East and the Gulf: Algeria, Djibouti, Egypt, Libya Arab Jamahiriya, Tunisia, Morocco, Somalia and the Sudan. It will be noted that the secretariat of the ECA was instrumental in the establishment of the third Division of Africa Central 1/.

1/ Resolution 26 of the Third United Nations Conference on the Standardization of Geographical Names, 1977, Athens, Greece.

The purpose in seeking an additional Division was to creat the opportunity for the group of States in Central Africa sub region that is predominantly French speaking to find itself in matters of standardization of geographical names, since governments in this area had embarked on carrying out their own mapping programmes.

3. A brief look at the mapping situation in Africa, the amount of work executed after independence or better still in the past 20 years reveals less than 30 per cent. It has been also noted that a number of enviable national cartographic institutions have declined and/or even collapsed. The element to ponder upon is whether many national geographical names authorities where they existed are still strong or even existing? The past 20 years have been characterized by frequent changes of governments sometimes violently. In a number of cases there have been forced movements of populations very often across frontiers. A lot of damage done to habitations, villages, communication systems as well as to people and old persons who by African traditions are the custodians of culture including languages and unwritten history.

4. The coming of independence brought with it the urge to put right the wrong, in some cases introducing wrong toponymy. The practice where legitimization did follow the processes of established rules and guidelines recommenced by the United Nations Conference on the Standardization of Geographical Names. Africa has seen the renaming of features as often as new leader ship comes to power. Moreover, there have been cases where living personages have named geographical features after themselves and on death or being deposed the names are changed. Having seen that it takes a lot of trouble, time and scarce foreign exchange to publish a topo map at 1:50 000, yet a feature may cover several sheets in some cases extending beyond national frontiers the inconveniences are also extended to the international community and organizations such as the International Civil Aviation to name but one.

5. On the other hand, responsible governments of Angola, Zaire and Zimbabwe as an example have informed the world of names changed and having followed the established rules. It is true that occupying colonial powers more often distorted indegenous names through lack of sympathy and understanding or by deliberate imposition of their dominance. African maps still bear hundreds of thousands of such names. The accusing finger cannot be pointed only at former colonial powers. Today, there are African countries or cultures as well as ethnic groups under non indigenous occupation, alien rule or occupation. It is expected and it should be that Africa must resist change or force a change of local indigenous toponymy in persuance of perpetuating domination to the disadvantage of minorities or the supressed (even if in majority). Earlier while listing

Linguistic Divisions for Africa it was not omission that the Dutch German Division includes South Africa. There is no logic that the majority of the population with its own languages and where natural features in their land had their names erased that these features now carry European ones. These people are neither represented nor the richness of their languages brought to the attention of the world community and the Conference itself.

LINGUISTIC DIVISIONS

6. Turning to activities of Linguistic divisions the problems in Africa are enormous. The Divisions have to assist in tackling transcription and transliteration problems resulting from inherited colonial structures namely English and French orthography The Arabic Division needs to work closely with other Divisions in Africa as languages and ethnicity do not respect man made boundaries. Another difficulty facing Africa Divisions is lack of funds to organize toponymic training courses or workshops. Africa with some 28 States classified as Least Developed Countries the bulk of this group being in Africa south of the Sahara, is still plagued by economic crises. The Organization of African Unity in its areas of priority action recommended that at sub regional, regional and continental levels "African States should take steps to set up or strengthen sub-regional ... economic groupings, in a rational and harmonized framework so as to ensure an effective co-operation among member States first of the same sub region and then among the different regional economic groupings" 1/. At international level APPER stresses " - strengthening of solidarity and consultations among African States is necessary for a better awareness of Africa's interests - owing to the fact that Africa is lagging behind technologically, it should insist within the Specialized Agencies of the United Nations for special treatment to be accorded particularly in the areas of technical co-operation, training and research".

CO-ORDINATION

7. Document E/ECA/NRD/CART/136 on Status of Standardization of Geographical Names in the Africa East Division reminds the Conference of the role of linguistic divisions. We have seen that United Nations Group of Experts on Geographical Names (UNGEGN) has different Working Groups dealing with specialized areas in the standardization of geographical names. We have noted

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1/ Africa's Priority Programme for Economic Recovery (APPER) 1986-1990.

that the deliberations of the Group of Experts are finally looked into by the Conference on the Standardization of Geographical Names. World Cartography Vol. XVIII 2/ devoted to the standardization of geographical names ably puts together nearly almost all that is needed to know about this topic. But the African situation of under development lack of resources to bring awareness to policy makers of the need to consider standardized geographical names as an indispensable tool to safeguarding heritage and history itself as well as a mark of nation s credibility.

8. It may be pointed out Africa needs more help in term of organizing toponymic courses. Above all it needs to co-ordinate its Divisions in order to bridge gaps that continue to divide the African peoples among linguistic camps. The co ordination that is advanced in this paper intends to integrate efforts of linguistic Divisions into Africa's economic development and structural transformation programmes. If the Conference or the Divisions themselves feel that linguistic activities being co-ordinated from outside Africa offers the best choice, one element will have been achieved and that is Africa will continue to receive ready made answers for its development problems rather than participate in the seemingly laborious process of finding its own identity and aligning itself with the way Africa is approaching its development problems. In this regard, the seventh United Nations Regional Cartographic Conference for Africa is well placed to recommend a system or machinery for the better design and co-ordination of regional projects with regard to standardization of geographical names. This does not interfere with the present structural arrangement, but assists in strengthening strategies for the development of reliable maps in Africa, at the same time safeguarding national interests in this field.

CONCLUSION

9. The Agenda item on this topic calls for an inter-divisional co-ordinating machinery. The views and recommendations will be respected by the United Nations as provisions were made to accommodate views and proposals that will strengthen the standardization. By way of conclusion, below are two extracts from "Africa and the Africans and their Historic Challenge".

> "Indeed, my aim today is to share with you my perception of the nature, content,scope and complexity of the

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2/ UN Sales No. E.85.1.23.

> historic challenge that faces Africa and the Africans. Unless this challenge is addressed urgently, vigorously and persistently with all our considerable human and natural resources, Africa and the Africans will remain in perpetuity the underdogs of the world marginalized, peripheral exploited and despised ..... As we all know, development is a systematic and interactive process. The African development problematic has its root cause in the brakdown of the system (cultural, linguistic etc) and the lack of effective sectoral linkages .

10. It is not advocated to set up an institution for this purpose but that the role should remain within the United Nations through its Commission the Economic Commission for Africa (ECA).

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CARTOGRAPHIC ACTIVITIES IN ETHIOPIA (1986-1989)

By

Ethiopian Mapping Authority

I. INTRODUCTION

1. Ethiopia being one of the developing countries, great emphasis is given to surveying and mapping activities in order to study the natural resources and to accelerate the overall socio-economic development efforts.

2. The country is potentially rich in natural resources but the development of these resources could not be carried out in full swing partly due to the inadequate terrain data base which is a prerequisite for planning and development of its resources.

3. Surveying and mapping activities undertaken by the Ethiopian mapping Authority (EMA) embrace training of manpower, acquisition of scientific equipment and carrying out different kinds of mapping suitable for agriculture, forestry, water and mineral resources, road construction and other fields of development.

4. EMA is an autonomous government organization responsible for surveying, mapping, remote sensing and geographic studies. It provides cartographic services to government and private organizations.

5. Although it has been established 36 years ago, it was not fully engaged in the preparation of topographic maps until the last 10 years, because it was mainly engaged in providing cadastral services. At present, the Government gives full support in strengthening the Authority.

6. Presently EMA executes its task by using modern geodetic survey, photogrammetric, cartographic, remote sensing, map reproduction equipment. Its staff development programme is being intensified through in-service training at EMA and abroad for higher and specialized training.

7. Following are the status of activities carried out by EMA.

II. GEODETIC SURVEYING

8. One of the important considerations taken is to provide the basic control data. The national geodetic network consisting of first, second and third order is uniformly extended over an area of 490,000 km2 to the regions of relatively high potential in natural resources.

9. Extension and intensification of the national geodetic control network is being accomplished on a continuing basis at an average rate of 30 000 km2 per year using classical approaches and Doppler surveys. However, some isolated areas are mapped using local control and Doppler depending on the application of the end-products. Geodetic control nets are also extended as required to regions where large-scale mapping and engineering survey data are required. The controls during this type of work are of the second and third order for isolated surveys necessary for irrigation, hydroelectric dam construction, town planning, railways and water resources ranging from 1:500 to 1:10,000 scales.

III. AERIAL PHOTOGRAPHY

10. Since 1957 Ethiopia has been covered by 1:50,000/1:40,000 scale wide angle aerial photographs for the preparation of 1:50,000 and 1:250,000 scale topographic maps. Other large-scale photographs ranging from 1:8,000 - 1: 20,000 covering major towns, agricultural and hydroelectric dam sites, railway and highway construction projects are also available. From 1980-1989 photographs covering an area of 306,000 km2 have been flown at 1:50,000/1:40,000 scale. The small- and large-scale photographs are used for topographic mapping of various scales and for photo interpretation.

IV. TOPOGRAPHIC MAPPING

11. All sort of maps are produced in varying topics, scales, and colours and formats to fulfil particular map requirements of the country. Ethiopia is covered with 1:250,000 scale maps. This is the largest scale map available covering the whole country with 97 map sheets. These maps were published from 1965-1972. Due to the development activities being carried out in the country, there is wide demand for this product, but most of the maps are fairly old and need revision. But because of other priorities it has not been possible to update these maps. Since 1971 EMA has been involved in the production of 1:50,000 scale national topographic map series which is found to be quite sufficient for multi-purpose use. To cover the whole country at this scale over 1,700 map sheets of fifteen by fifteen minutes quadrangle are required. The choice of priority areas for mapping depends on agricultural, geothermal, hydro-electrical, forest, mineral and water resources potentials. To date, about 29 per cent of the country mainly the central, western, north-western and south-western areas have been covered.

12. In addition, a large number of small-scale maps ranging from 1:500,000 to 1:2,000,000 scales dealing with various topics are available. Among these are 1:1,000,000 and 1:2,000,000 topographic, land use, tourist, road network maps as well as other topics.

13. The demand for large-scale mapping ranging from 1:2,000 to 1:10,000 for town planning, irrigation and hydro-electric dam sites and other engineering projects is increasing. Since 1983, maps for 50 major towns and for 30 other projects covering an area of 6,000,000 ha. have been compiled and additional work is in progress.

14. Special purpose maps such as land use, soil, geological, climatological and historical maps are also prepared jointly with other ministries.

V. THEMATIC MAPPING

15. In addition to the topographic and special purpose mapping, thematic mapping covering a wide range of topics are prepared based on geographic research for projects such as national and regional atlases. The multi-colour national atlas of Ethiopia is now completed and is in circulation. Work on a geographic gazetteer to facilitate the location and identification of feature names is in advanced stage of production.

VI. MANPOWER AND EQUIPMENT

16. The Ethiopian Mapping Authority, being the national cartographic service, is responsible for all surveying, mapping and remote sensing activities. During the reporting period EMA has over 385 employees, out of these, 49 are on contract basis.

17. The Authority has modern surveying, photogrammetric, cartographic and map reproduction equipment, orthophoto system and medium capacity electronic computers. The demand for mapping services and the available equipment and trained manpower do not correspond. The Authority, in its endeavour to fulfil its responsibilities and increase the production in some areas of activity, has introduced a shift system of work.

18. Among the major equipment that the Authority is lacking at present are GPS systems aerial cameras and aircraft. To date these activities are supplemented by acquiring services on rental basis.

VII. FUTURE ACTIVITIES

19. Future activities of the Ethiopian Mapping Authority embrace undertaking further technical operations, technology transfer and training of manpower abroad through scholarship grants from friendly countries and international organizations.

A. Map revision programme

20. The territory of Ethiopia covers over 1.2 million km2 of land mass as well as the coastal water of the Red Sea along a 1,200 - km shore with numerous islands. As mentioned above under section IV, 97 map sheets of the 1:250, 000 scale standard series and 1,700 maps of the 1:50,000 series are required for full national coverage. The most recent compilation date of the quarter million series was 1972 using photogrammetric methods. Evidently, this series requires map revision immediately. EMA could benefit from the experience of other bodies in the selection of efficient methods of revision.

21. The period of revision is tentatively set at 10 years. For the task, cyclic aerial photography and/or satellite imaging are required. At the moment, EMA itself does not own aircraft capable of aerial photography. It acquires such service either locally or from abroad depending on the photo scales. To remedy this situation, EMA is planning to acquire its own aircraft in the medium term. Satellite imageries could be acquired from established sources using standard procedures.

22. Different methods will be employed for the revision. One approach would be to produce orthophoto maps at convenient scale using the Authority's orthophoto system, which is recently acquired and is in the process of installation, and to transfer the detail directly onto a transparent base. Finally, this is brought to 1:250,000 using photo-mechanical magnification. The revision of 1:50,000 maps could be carried out using similar methods or using stereo-plotters to acquire the required control points.

B. Orthophoto mapping and remote sensing

23. Orthophoto map production will commence in 1989. The advantages of such maps over line maps is the rapid speed of production. In addition these maps are found to be more desirable than line maps for irrigation, forestry and town planning purposes.

24. Since there is only 29 per cent national coverage with standard series 1:50,000 maps, there is a shortage of such maps. To meet adequately the growing demand for the maps, more accelerated production of the 1:50,000 maps or acceptable substitutes are required. The present rate of production is about 40 maps annually and mapping is carried out continuously. Occasionally, mapping is carried out spasmodically at this or larger scales on demand available basis to satisfy the request of end users.

25. A remote sensing section has been established in the Authority. At present, preliminary activities are focused on acquisition of basic equipment and training of personnel both locally and abroad. Initial production stages will involve pilot projects before embarking on full-scale production. The section will also function as a national user facility centre. Present areas of interest identified to date include crop yield forecast, forest inventory, map revision, inland water pollution studies, river valley development master plans, water and soil conservation, land use and map revision using satellite imageries.

26. Another area of interest in the long run is digital mapping and establishment of data bases. As this involves new investment of capital in hardware and software, there is a plan to evaluate the hardware and software requirements for the establishment of a Geographic Information System.

C. Training programme

27. Since the higher educational institutions within the country do not produce qualified personnel in the field of surveying and mapping, the Authority is faced with a critical shortage of trained manpower. It has therefore introduced its own in-service training during production just to mitigate the situation.

28. Areas of priority at present are remote sensing and computer applications. Further training opportunities are given to competent employees to study abroad through scholarship grants obtained from friendly countries and international organizations. The output of these training programmes could be rated as satisfactory and needs to continue in the future to fulfil the ever-increasing demand for qualified personnel.